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A Nine-Year Science Program

Focused on

Better Thinking

More Intelligent Behavior

★

BASIC STUDIES IN SCIENCE

W. L. Beauchamp,
Directing Editor

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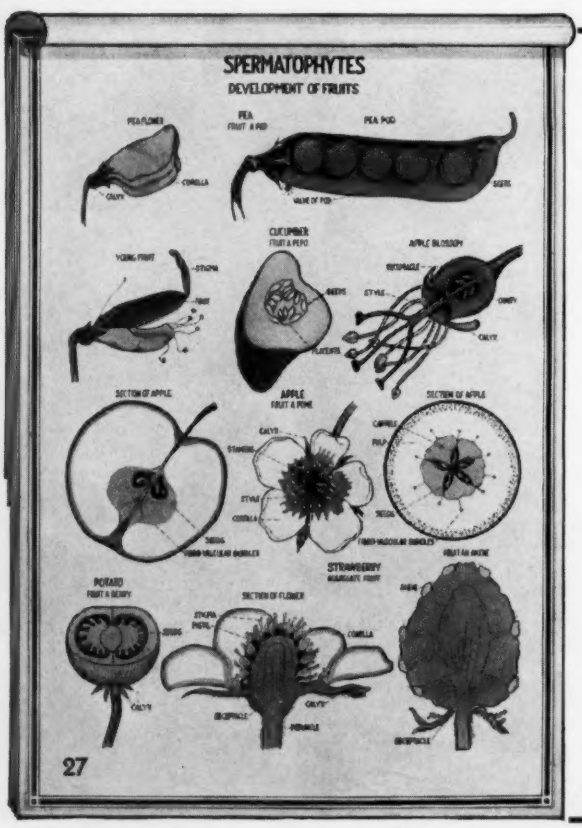

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THE TENTH ANNUAL meeting of the American Science Teachers Association will be held in New York City, December 28, 1942.

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VOLUME I FEBRUARY, 1942 NUMBER I

Trends in Science Teaching

IRA C. DAVIS

University of Wisconsin Madison, Wisconsin

Present trends in science teaching have been under active consideration by the National Science Committee of the Division of Science Instruction of the N.E.A.—a committee headed by Dr. Ira Davis of the University of Wisconsin. Dr. Davis here discusses the trends in science education as found through active contact with the work.— Editor.

A TREND means a tendency. A trend may be desirable or undesirable. You may agree with some trends and disagree with others. Any movement or program in which there is a genuine desire for change is a trend. Any program promoted by propaganda and high pressure salesmanship or advertising is not a trend. It is a venture. Any trend to be worthy of discussion should have continued for some length of time. It should have received general recognition as a movement. It should be growing. Once a movement is on the decline, I prefer not to consider it a trend.

General educational purposes and objectives have undergone many changes. The same situation is true in science education. Changes in purposes and objectives go hand in hand with changes in our ways of living. Probably the most significant trend in science education is the change in objectives. Past investigations indicate that information or knowledge was the most important objective. This was followed by interests, scientific attitudes, methods and skills. Today knowledge is seldom listed as most important. There is almost unanimous agreement that teaching pupils how to use the scientific method is most important. This is followed by scientific attitudes and then knowledge. We must admit there is a great deal of difference between what teachers say they should do and what they are doing.

AT FIRST thought you may not think that this change in objectives is significant. But this change in point of view is slowly changing our methods of teaching and the selection of content. It is changing our textbooks, our reference material, our laboratory exercises and our whole point of view in attacking problems.

Now we are going one step further by stating objectives in the form of desirable functional outcomes or in terms of children's needs. And that means we will be directing our science teaching more and more toward the acquisition of these outcomes. This change will still further influence our methods of teaching. These outcomes will begin to function when they influence the ways boys and girls live and do things. I believe this shift in emphasis on objectives can be summarized by saying that we no longer will teach subject matter just for the sake of subject matter, but rather teach boys and girls through the medium of science subject matter.

THE SECOND most significant trend in science teaching is an outgrowth of our change in objectives. It is the desire on the part of many teachers to place more emphasis on the social implications brought about by scientific

discoveries and inventions. These teachers feel science should help to give boys and girls a better understanding of these social problems. New units or courses in health, safety, conservation, sex instruction, consumer science, and the frank and open discussion of many controversial issues in classes is evidence that many science teachers are meeting these problems more realistically than ever before. Furthermore, boys and girls and many parents are demanding that we do more of it. I know some science teachers throw up their hands in horror when they hear of these discussions of controversial issues. Is the desire for fact and truth good science or poor science? Is the desire to solve problems on the basis of fact good science or poor science? Will any one deny that the search for truth is a desirable scientific attitude? Are we attempting to solve these controversial issues on the basis of fact or on the "taboos" which have been built up to conceal the facts? This second trend is further evidence that science is "growing up." It is everlastingly searching for the truth.

THE THIRD most significant trend is development or outgrowth of the first two trends. It is the more careful selection and evaluation of what we are teaching, that is, subject matter. What is happening to subject matter is worrying many teachers. There is nothing new in this situation. Our total quantity of science subject matter is increasing at an enormous rate. Nearly half of all the books copyrighted in 1940 were books dealing with some area of science. It is impossible to teach our pupils any large portion of this total. This third trend is simply a reorganization of all of our school subjects. Science is in the same situation as the other subjects. Probably this trend may be made more understandable by stating a few questions.

(1) How would you plan a science program when you knew pupils could learn relatively only a small part of all that could be learned? If they learned this relatively small part, they would have learned more than boys and girls had ever learned before.

(2) How would you select out of this total the content which is most useful to pupils, and how would you decide what is most useful?

(3) Would you be willing to admit at the outset that possibly just as good results could be secured by beginning with the problems or needs of pupils and then selecting the content which would be needed for the understanding of these problems or needs? If you are ready to give the answer to these questions, then you are in a position to begin the reorganization of our science program. In making this reorganization, you should not forget that in the past pupils in the four-year senior high school have, on the average, had less than two years of science.

THIS SHIFT in emphasis from subject matter to the child has been in progress for the past fifty years. This shift has kept pace with the percentage of graduates of secondary schools who entered college. In 1890, science was taught in high school to prepare pupils for college. All of the emphasis was on subject matter. Practically all of these graduates entered college.

Then came subject matter for the mental discipline it offered. Then, when more pupils entered high school and a smaller percentage entered college, subject matter with applications became important.

In 1930 the general slogan seemed to be every boy and girl is entitled to a good high-school education. All subjects must contribute to that education. In the 31st yearbook of the National Society for the Study of Education, principles and generalizations were set up as our purposes. A knowledge of these broad generalizations and principles was needed if boys and girls were to understand the world in which they lived. Emphasis was also placed on scientific methods and attitudes and thinking.

In the Progressive Education report,

"Science in General Education," the child determines what is to be taught. Here you have the child-centered school — not the subject-matter school. Where will this trend end? Will we finally settle down to a middle of the road position? Must we begin with life problems and search out the subject matter that is most useful, or shall we begin with subject matter and make it function in helping pupils solve their problems and meet their needs?

THE FOURTH trend is the change in the kind of science being taught in the elementary school and to some extent in the junior high school. The tendency is toward teaching science as one complete area and not as specialized areas. There is an increasing tendency to base this science on the experiences and activities of children rather than the printed page. Many schools are providing a continuous science program in all of the grades of the elementary school and the junior high school. This change in science in the elementary school and junior high school is slowly changing the science program in the senior high school. This is evident in the attempt to organize three-year sequential programs. The organization of other new courses, such as physical science, senior science, descriptive science, and applied science, is evidence that the attempt to break down the narrow departmentalization of subject matter is expanding into the senior high school.

The rapid growth in enrollment in the secondary schools has produced many changes, but I am not certain they should be called trends. Can we say that the increase in the teacher's load of more and larger classes is a trend or is it a necessity? Possibly I should say administrative convenience. I do not believe any one will say that this increased load has improved teaching. Can we say that larger classes and smaller budgets are the main causes of the increased emphasis on the demonstration method of teaching, or had teachers previously come to believe the demonstration method was a better way of teaching? The increased use of demonstration teaching is slowly bringing about changes in our laboratory procedures. More emphasis is being placed on teaching pupils how to solve problems by the use of the scientific method and less emphasis on the acquisition of information. This is more a reversion to the original laboratory methods than it is a trend.

CAN WE say that the increased enrollment in our schools with an assumed lowering of the average intelligence has lowered our standards? The meager evidence available does not give any definite proof for such a statement. Rather, the evidence seems to show that the average scores on texts now is as high as it ever has been. Further evidence seems to indicate that the average boy or girl knows more science now than at any time in the past. Do not assume all of this science is learned in school.

There is a changing point of view in evaluation or testing. Many new types of tests are being used. The shift is from pure information items to questions which attempt to get at outcomes, applications, understandings, appreciations, attitudes, and methods. The movement has not continued long enough to be considered a trend but it has possibilities which science teachers should not ignore.

In working with the National Committee on Science Teaching for the past three years, and in which hundreds of teachers took active part, I have come to feel that science teachers are ready and eager to work together to solve many perplexing problems in science teaching. They are more than willing to consider all of these trends and movements, and plan a science program that will really function in the everyday lives of boys and girls. Workshops, summer institutes, and two or three day programs planned by science teachers is further evidence of this determination

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Editorial and News

American Science Teachers Association Establishes New Journal Service

THE AMERICAN Science Teachers Association has made another major step forward — the beginning of improved and regular journal service for its membership. At its meeting in Dallas, Texas, December 29 last, it adopted THE SCIENCE TEACHER as its official publication. This move, we believe, will not only increase its membership very materially, but will also enable it to make its work more effective. At the same time, by adopting one of the present national publications it aids materially in the early improvement of journal service to science teachers nation wide. We heartily welcome this outstanding national organization and its many affiliated state and regional groups to the community of associations that we serve. The willingness with which it shares this journal with other groups emphasizes the liberal and democratic attitude that exists within the association, an attitude that is fundamental to the success of any national organization that seeks to coordinate association activities nation wide.

THE PROVISION for publication service is only one of the moves taken by the American Science Teachers Association for the benefit of science teachers. In fact, its early organization was due to an effort on the part of national leaders in science education to perform services for state and regional groups which they themselves were unable to accomplish. It had its inception with a committee of the American Association for the Advancement of Science on the place of science in education, which decided after much investigation that a national organization was needed to consolidate and serve the interests of teachers on a country-wide basis. Otis W. Caldwell, then of Columbia University (now at Boyce Thompson Institute and permanent secretary of the American Association for the Advancement of Science) deserves much credit as one who originally sponsored the movement. Some of those on the organizing committee were Harry A. Carpenter, Rochester (N. Y.) Public Schools, chairman; Hanor A. Webb, Peabody College for Teachers, Nashville, Tennessee; Phillip G. Johnson, Cornell University; and Ralph K. Watkins, University of Missouri.

In type of organization, the American Science Teachers Association is modeled somewhat after the plan of the American Chemical Society, a plan which is successfully followed by several state science teachers associations, notably New York, Iowa, and Nebraska. Basically the plan depends on the local association, which in turn manages its own affairs according to local needs. Each local association elects a member to the board of directors of the national association and so shares in the control of activities sponsored. At present there are over 20 of these affiliated groups in addition to a considerable direct membership.

AS TO THE aims and objectives of the American Science Teachers Association as established after much investigation and consultation, we can best present them by quoting from its constitution.

Article II. Aims and Objectives.

Section 1. The general aim of this association shall be to encourage and coordinate the development of science teaching through existing organizations of science teachers and other educational agencies.

Section 2. The specific aims of this association shall be as follows:

a. To encourage science teachers to participate actively in their local organizations of teachers.

(Continued on page 36)

WELCOME IOWA

We are pleased to announce that the Iowa Association of Science Teachers by recent action of its board of directors is now using THE SCIENCE TEACHER as its official publication. We welcome Iowa teachers most cordially to our growing family of science teacher groups, as we feel they are not only a strong organization, but also very active in furthering the cause of science education. Miss Delma Harding of Newton High School, Newton, Iowa, is president of the association.

As Iowa editor on our staff, Dr. Paul Kambly of the University High School, Ames, Iowa, has been selected by the association. He is already known to us as an able and active worker among teachers, and a very acceptable leader in association meetings. Unquestionably he will see that Iowa teachers are well served.

In adopting The Science Teacher as its official publication, we believe that the Iowa Association of Science Teachers is taking an important step toward increasing interest in association activities, in building association consciousness, and in achieving more effective work. The members will now receive a very tangible and helpful reminder that they have a part in the science education program of the state for they will receive an association journal regularly that gives personal attention to their work.

As with other science associations that we serve, we want Iowa to use The Science Teacher in just the way it will serve them best and to adapt it to their particular needs.

(Note: For an announcement of the invitational meeting of the Iowa Association of Science Teachers at Iowa State College, Ames, Iowa, February 28, see page 26.)

INDIANA CHEMISTRY ASSOCIATION

The Indiana High School Chemistry Teachers Association is holding its annual meeting this year at Valparaiso, Indiana, May 1-2. An attractive program is being planned and a considerable increase in attendance is expected. Charles Sims of Shelbyville High School is president and Lois E. Martin of Shortridge High School, Indianapolis, secretary-treasurer. Anyone having suggestions as to the program should write to these people.

ILLINOIS CHEMISTRY ASSOCIATION

Decatur is to be host to the Illinois Association of Chemistry Teachers at its spring meeting this year. The group will meet there in the senior high school Saturday, April 11, for what promises to be a very worth-while meeting.

In the absence of the president of the association, Ray C. Soliday of Oak Park, who is now connected with the army in the field of chemical service, C. W. Dewalt of Decatur has been selected for the task of working out the program. He and Dr. Zimmerman of James Millikin University have already made considerable progress.

In relation to the present national emergency it is planned to have some one discuss what can be done in high-school chemistry to acquaint students with explosives, incendiaries, fire-fighting, etc. Project work will be discussed. A student of the Decatur High School will exhibit a unique device he has invented which he calls the "Atom-O-Graph." The new Decatur High School chemical laboratories, which are of most modern design and equipment, will be open for inspection and Mr. Nelson, who is in charge of the work there, will discuss the problems encountered in planning and equipping them. Other features of the program are being considered and the committee will welcome any suggestions from the membership.

(Continued on page 40)

Making Slides as a Biology Hobby

ILLA PODENDORF

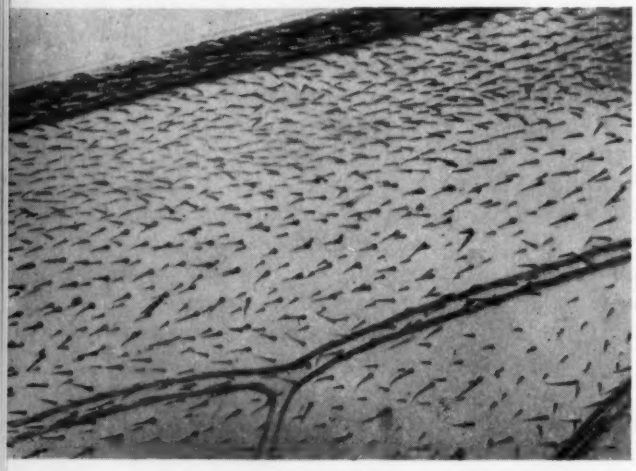
Newton High School

Newton, Iowa

STUDENTS find the microscope a fascinating piece of equipment in biology and many of them enjoy building a hobby around it. This is not at all difficult, as it may seem at first thought.

The first problem is that of time. Students who are enrolled regularly in biology classes usually find only enough time during the class periods to learn the ordinary use and care of the microscope. They use the permanent slides available and prepare a few wet and dry mounts themselves. This stimulates some interest, but if a worth-while hobby is to be developed additional time must be found. In some school organizations the sixth period of the day may be used for such activities. It may also be possible for the student to arrange to use their study periods, which they ordinarily would ordinarily would spend in study hall, in the biology laboratory. Students who have completed their biology course are often interested in keeping contact with the work by such an arrangement. If the biology room has a work room or activity room in connection with it, this plan works particularly well. It works very well even though they may need to occupy the same room with the scheduled class. They should have a small cupboard and table space assigned to them. If this is not possible, almost any corner will do. These students do not interfere with the work of the class; rather they serve to motivate it.

Photomicrograph of wing of bee



A SECOND problem is equipment. After preparing temporary wet and dry mounts of things they are interested in, students often ask to make permanent slides. If we think in terms of paraffin ovens, microtomes, and full staining equipment, most of us find that we do not have the apparatus. However, many useful and interesting slides can be made without this expensive equipment. The following suggested list of materials, in addition to slides and cover slips, serves the purpose for some common objects, making it possible for the students to prepare some very worth-while permanent slides. Most of these materials can be procured from a good drug store with very little expense.

Ordinary rubbing alcohol (70 per cent strength) for preserving.

Absolute alcohol for dehydration of specimens.

Distilled water for dilutions.

Formalin for fixing and preserving.

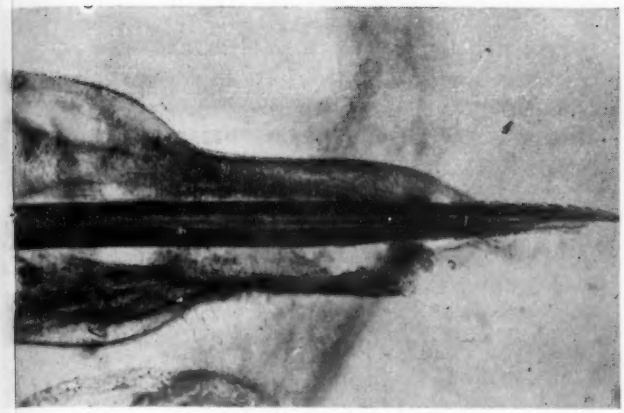
Xylol (xylene) is a good clearing agent and dissolves the mounting media listed below.

Clarite, a synthetic resin mounting medium.

Canada Balsam may also be used for mounting.

Slide labels for labeling slides.

We assume the student has learned to operate the microscope with a reasonable amount of skill and knows how to prepare both wet and dry temporary mounts. His purpose now is to make some of these slides permanent. A slide



The sting of a worker bee

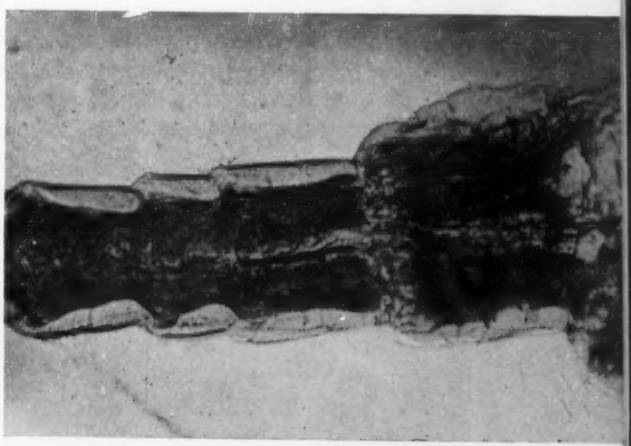
of raw cotton is a good one to start with. Be sure the slide and cover slip are clean and dry. Lay a slide on a sheet of white paper and draw a line around it. Draw diagonal lines from the corners to cross at the center of the rectangle. The center of the slide is where the lines cross. Place material in the center of the slide thus located.

WITH TWEEZERS place a few fibers of raw cotton in a small quantity of xylol to clean and remove any foreign particles or oils. Place a small drop of clarite on center of slide and put the moist fibers on top of drop. Seal with a cover slip. If the cover slip is lowered slowly from one side there iis less danger of air bubbles forming. The slide must rest on a flat surface for three or four days to allow the clarite to harden. In a similar manner, slides can be made of cotton fabrics. A small piece about one-fourth inch square is rinsed in xylol then placed on center of slide, a drop of clarite placed on top of it, and a cover slip added. Permanent slides can be made of many other fabrics—silk, rayon, wool, linen, etc.

The amount of clarite, or balsam, to use is best learned by experience. It depends upon the size of the cover slip and the thickness of the specimen to be mounted. Generally speaking, it is best to place the moist specimen upon the slide and to cover quickly with clarite. However, when the material is very fine, it often works better to place the material on the drop of clarite. A little experience will dictate the best procedure for various materials.

It is necessary to have students label their slides **immediately** to be sure they are identified correctly. The label should gives name of the material, date and students' name. An important consideration is that they be uniform in lettering and arrangement.

SOME STUDENTS who are especially interested in plants may prepare a collection of slides of various flower pollens to show the variety of shapes and sizes. These are most easily made by placing clarite on a slide and dusting pollen on top, then covering with cover slip. The greatest difficulty with making slides in this manner seems to be that the pollen will pack together rather than dust evenly. Moistening first with xylol sometimes helps.



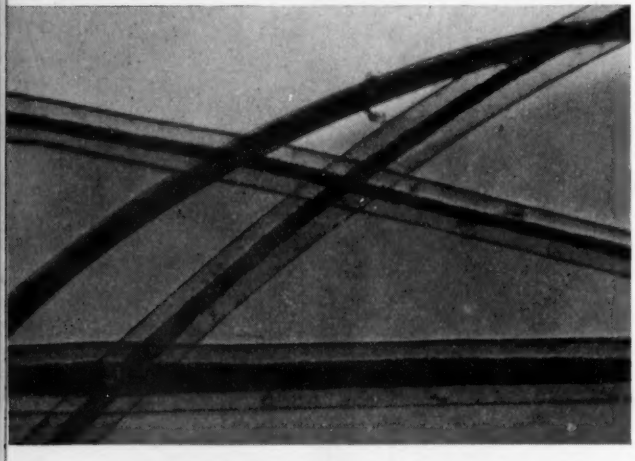
The base of antenna of a butterfly

A similar collection of slides may be made of various fungus spores. These can be easily dusted on the drop of clarite. In the same way slides may be made of various molds. Usually a number of slides must be made before a good mount is secured. Bread mold is a good one to work upon because it is so easy to culture.

An interesting set of slides are of kinds of mammal hair. A few strands of hair are first washed in strong alcohol, then rinsed in xylol and mounted in clarite. Students may start by mounting some of their own hair and then trying that of their pets. The collection may be enlarged by going to fur dealers and finding as many species as possible. Students are fascinated with the characteristic differences they find in various kinds of hair.

FOLLOWING the same plan as that used for mounting mammal hair, bird feathers may also be mounted. They show an interesting variety of formations. The greatest difficulty in making these slides is to avoid air bubbles. It is necessary to take each step very slowly.

Insect body parts make useful permanent slides. A good one to begin on would be the scales from the wings of moths or butterflies. Hold a piece of butterfly wing over a slide. Scrape it lightly with a scalpel. Brush the scales to center of slide, dampen with xylol, and cover with clarite. If the insect has been thoroughly dried, the other parts may be cleared in xylol and mounted in clarite. Many mounts are better if the insect first has been preserved in alcohol. If this is true, the part to be mounted should be removed, allowed to stand in pure (or nearly pure) alcohol, then removed and the alcohol evaporated from it. The part can then be cleared in xylol and mounted in clarite. In this way good slides can be made of thin insect wings to show the tracheal tubes or stiffening structures. Honey bee rear wings may be mounted together to show how the two wings are held together by a series of hooks. The legs of insects will show the adaptations for special purposes: for example, the spine, combs, and pollen baskets of the honey bee.



Photomicrograph of raccoon fur

THE ANTENNAE of insects may also be mounted. Whole insects may be mounted if they are small enough. The mosquito, body lice, etc., make good slides of this kind. Grasshopper mouth parts carefully arranged on the slide in several drops in thick Canada Balsam or clarite make a good slide. A great deal of balsam must be used because the mouth parts are thick. Balsam is usually better than clarite for thick, heavy parts.

Students may try mounting the sting of a worker bee. For best results they should use freshly killed bees. Remove the heads, pierce the abdomen several times with a pin, and place the bodies in water to stand until the next day. Some decomposition will take place in this time. To remove the sting hold the bee in the left hand, and using the right hand, grasp the stinger carefully with a pair of fine-pointed tweezers. It may be necessary to make several attempts before a good specimen is secured. Place the sting in formalin and let stand for an hour or more. Remove and rinse with clear water. If more color is needed, it could be stained for a few minutes in eosin or mercurochrome. Place on the slide and add a drop of alcohol and one of distilled water. Drain this off and using pure alcohol give it two or three more baths. Rinse in pure xylol the same way. Allow the xylol to evaporate but do not let the sting dry too much. Mount in thick Canada Balsam.

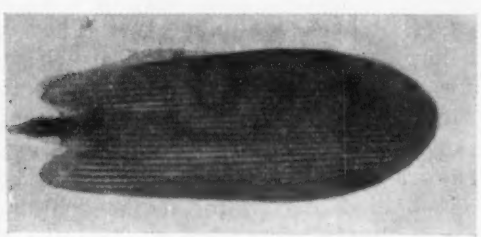
IF THE students wish to do something more difficult, they might try permanent slides of algae. Conjugating Spiro-

gyra is a good one to attempt. A quantity should first be preserved in ordinary formalin. After it has been thoroughly preserved, clip a few short lengths of the filaments with sharp scissors and place upon a slide. The excess solution may be drained off by standing slide on edge on a blotter or paper towel. A drop of alcohol and one of distilled water dropped on the filaments, allowed to stand a few minutes, and drained off will start the dehydration process. Follow this with pure alcohol, two or three changes, rinse with xylol in the same way, and let it stand until all the excess xylol has evaporated, but the filaments themselves must remain damp. Mount with Canada Balsam and allow to dry. Clarite can be made thicker and will work about as well. Other species of filamentous algae may be mounted in the same way.

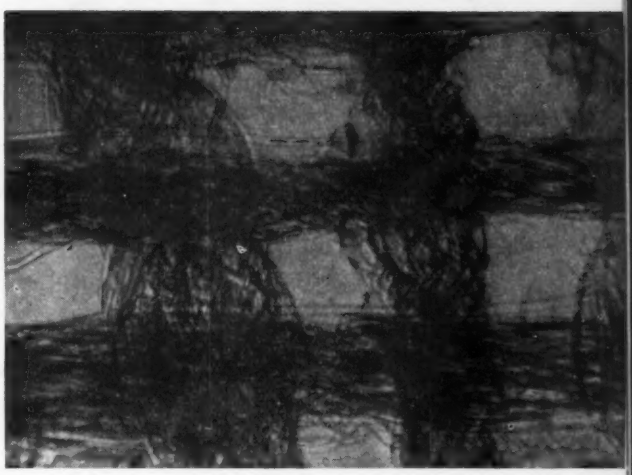
Stained blood slides such as those that are freshly made for class demonstration can have a drop of clarite and cover slip on them to preserve them.

WITHOUT doubt there are many more suggestions that could be made for making permanent slides with very little equipment. When students begin such a project they may develop it as far as they like and many times show much originality.

The value received from such a project is many fold. The students have a collection of slides and have acquired a lot of good experience using the microscope. To accomplish the best results, they have had to develop some scientific procedures, such as care, accuracy, neatness, orderliness, etc. They have had to do some original thinking and planning on their own. Perhaps after all the actual slides produced are of lesser importance.



Single scale of butterfly wing



Photomicrograph of cotton cloth

OHIO JUNIOR ACADEMY

A TRIAL Junior Academy of Science meeting for students in Ohio was held in the spring of 1940 in connection with the fiftieth anniversary celebration of the Ohio Academy of Science. As a result of this trial meeting a formal constitution was drawn up and temporary officers elected.

On April 13, 1941, the first regular meeting was held at the Case School of Applied Science in Cleveland. Around seventy-five students participated with papers, exhibits and demonstrations. The idea of having district meetings in the fall with a state meeting in the spring was discussed and tentative plans made for them.

The officers of the organization for 1941-42 are: Dr. C. W. Jarvis, Chairman, Ohio Wesleyan University; Orval L. Linebrink, Secretary-treasurer, East High School, Columbus; J. W. Branson, Assistant Secretary-treasurer, West High School, Columbus. There is also an advisory council composed of senior academy members, representing the different districts of the state.

Three Insect Pests of Trees and Shrubs

LEE H. TOWNSEND

University of Kentucky Lexington, Kentucky

The following material, as presented by Dr. Townsend, can easily be made functional in the school community. It is vitally related to the environment and is the type of material that deserves careful consideration for use in the biology course.— Editor.

SHADE TREES and shrubs in full foliage and vigorously growing are among the most beautiful of all natural objects. Yet their beauty can be quickly destroyed by the attacks of many tiny insects that leave the plants defoliated and their trunks and branches scarred.

Good care plays an important part in protecting trees from these enemies, but most important of all is to recognize the insect and meet it with the proper control measures.

In the following account we shall consider three insect pests of trees and shrubs: the bagworm (Thyridopteryx ephemeraformis [Haw.]), catalpa sphinx (Ceratomia catalpae [Bdv.]), and fall webworm (Hyphantria cunea [Drury]). In addition to the comomn name, the scientific name is also given for reference purposes. These insects are widely distributed throughout the eastern United States and are known to many people. Certain of their activities have caused them to become well known. These activities will be described later as each pest is discussed.

THE LIFE histories are subject to some variation from year to year depending on the seasonal climatic conditions.

SHADE TREES, shrubs, and hedges, and in particuar evergreens, are subject to injury by a caterpillar which has a curious habit of crawling about infested trees in a bag-like case, whence its common name of bagworm, or basket worm. In the shelter of these cases the insects undergo all their growth and changes, after which the bags remain attached to the plants and are conspicuous objects on leafless trees and shrubs in late autumn and in winter, those constructed by the female being full of eggs while the males' cases are empty. These worms are pre-eminently pests on trees and shrubs along streets and in parks and private grounds of cities and towns.

The bagworm is native to North America and is generally distributed over the eastern part of the country. Its injury is most severe in the south-central states.

ALTHOUGH a very general feeder, the bagworm displays a particular fondness for evergreens of all kinds, especially for arborvitae; hence it seems probable that one of these was its original or normal food plant. During certain years when this insect is exceeding abundant it may be found on shade, orchard, and forest trees of nearly every kind. It is fond of willows and maples and the related boxelder; it is also found on the poplars and on mulberry, less often on the elms, and apparently still more seldom on the oaks. In the absence of its choice food it is able to subsist on the foliage of many other plants which may be available, but it does not seem to live on grasses and herbaceous plants generally.

The bagworm overwinters in the egg stage within the old bag of the female, and for this reason hand picking in wintertime is a worthwhile remedy. In the late spring the young hatch from the eggs, crawl out upon the twigs, make their way to the nearest leaf, and immediately begin to feed and to construct cases, or bags, for themselves. They spin a large quantity of silk, and attach to it, for additional strength and protection, bits of leaf or twig, evidently attempting also by this to disguise the nature of the case. The caterpillar is remarkably soft-bodied, except for its head and anterior, leg-bearing portions, and the soft hind region needs the bag for protection.

AS THE caterpillar grows, the case is constantly enlarged, bits of twigs and other small objects being used to ornament the outside, these varying with the kind of tree upon which the caterpillar is feeding. While small the case is carried erect, but when larger it hangs down. There is a small opening in the extremity of the bag through which excrement is pushed.

Late in the summer, the larva completes its growth, attaches the bag firmly by a silken band to a twig, strengthens it inside with a layer of silk, and within this retreat, which now becomes a cocoon, transforms to the pupa or resting stage with its head downward.

This resting stage lasts about three weeks, and then the adult emerges. The male works its way out of the lower opening as a small brown clear-winged moth. The female is wingless and never leaves the bag, merely protruding her body from the tip of the bag during mating. She works her way back into the bag, gradually depositing the eggs there. Having done this, she forces her shriveled body out of the opening, falls to the ground and dies. The eggs remain in the bag until the following spring then they hatch as previously described.

CONTROL: Hand-picking the bags in winter will remove the eggs, and is practical on smaller deciduous trees and evergreens. On large evergreens, however, it is almost impossible to see and gather a sufficient number to be worthwhile. When the bags are collected, they should be carried away and burned. If they are merely thrown about the ground. the eggs will hatch, and many of the worms will find their way to the trees. For a general infestation over shade trees in a neighborhood, the most effective control is spraying with arsenate of lead. It should be used at the rate of ½ pound to six gallons of water, applied as soon as the worms are noticed on the tree or shrub. The spray is most effective when the caterpillars are very young. It should be borne in mind, however, that any spray for evergreens ought to be used only when the temperature is below 85° F., as injury to the evergreen trees will most surely result if sprayed at high temperatures.

OUR NATIVE species of catalpa are comparatively free from insect attack. A few common shade-tree pests occasionally feed upon the leaves, but apparently do so only in the absence of food more desirable to them. There is one insect, however, the caterpillar of the catalpa sphinx, which feeds normally and exclusively on the foliage of these trees and in some seasons does considerable injury, often completely stripping the leaves from individual trees and sometimes from an entire grove.

The catalpa sphinx in its active feeding stage is a caterpillar only 3 inches in length. It is very variable in color, their being a light and a dark form, yellow and black prevailing. These colors with the large size of the insect and the stout black horn near the hind end of the body make it a conspicuous object on infested trees.

Under certain conditions the catalpa sphinx is looked upon as a beneficial insect. The caterpillars are such attractive fish bait that fishermen living about the swamps of Georgia, as early as 1874, hunted catalpa caterpillars as the best fish bait. In Florida at that time catalpa trees were cultivated for the purpose of rearing fish bait.

The parents of the caterpillars are large grayish-brown hawk moths. They have heavy bodies and powerful wings which measure three inches from tip to tip when spread. They fly mainly at night, and feed on nectar from flowers.

THE MOTHS deposit their white eggs in masses on the underside of the leaves. Sometimes as many as 1000 eggs have been found in a single mass. The eggs hatch in 10 days to two weeks, and the young caterpillars at once begin feeding on the foliage, at first in groups but later separately. They become full grown

(Continued on page 32)

Evaluation of Visual Instruction in Biology

B. F. HOLLAND and CHARLES A. CATE

University of Texas — New London, Texas

Although this study of visual instruction was made in biology, the results are applicable in all areas of science instruction and merits careful study.— Editor.

Problem and Procedure

AN EXPERIMENT was conducted in the New London High School, New London, Texas, during the 1940 to 1941 school session, to determine the effects varying amounts of visual instruction on the achievement of students in high-school biology. The main objective of the experiment was to test the effects of instruction with still projection aids, such as lantern slides and film slides, and the effects of instruction combining these aids with silent and sound moving pictures; and to compare these effects with those of instruction of the traditional laboratory type.

Three groups of students were taught by means of varying amounts of visual instruction: Group N, called the "non-visual aids" groups, was taught by means of laboratory demonstrations and experiments recommended by the State Department of Education, along with an occasional field trip, a visit to a museum, and a number of flat pictures. Group P, called the "partial visual aids" group, was taught by means of this same equipment plus the use of lantern slides and film strips presented by means of a Tri-Purpose projector and a combination opaque-lantern-slide projector. Group F, designated as the "full visual aids" group, was taught by means of both types of euqipment used in Groups N and P plus the use of moving pictures and a Bell and Howell Filmo Sound Moving Picture Projector.

THE TRADITIONAL program of instruction used in teaching Group N included lectures and class discussions, laboratory exercises and demonstrations, supervised study, and workbook assignments. The "partial visual aids program" included all these procedures plus the illustration of ideas and concepts by means of lantern slides and film slides. In effect, the teacher selected lantern slide sets and film strips to use in connection with the lectures and class discussions and to aid in reviewing each unit. The "full visual aids" program included a combination of all the foregoing types of equipment and aids and procedures along with selected silent and sound moving-picture films. The films were used as sources of information and as direct teaching aids. The showing of each film was preceded by a verbal introduction by the teacher which was designed to concentrate the attention of students on significant points; and each showing was followed by discussions intended to relate the content of the films to the subject matter being studied. The films, as a rule, were substituted in Group F for a part of the time given to the lectures and class discussions going on in Groups N and P. A total of fourteen films, all sound but one, were shown during the nine weeks covered by the experiment. In brief, except for the use of visual aids in varying amounts in Groups P and F, an effort was made to teach and test the three groups in essentially the same manner.

THE STUDENTS who served as subjects for the experiment were enrolled in three biology classes at the beginning of the school year. Administrative difficulties precluded efforts to match the groups for the specific purposes of the experiment. Later, each group was found to consist of students of sophomore, junior, and senior ranks in approximately the same numbers; so that the chance difference in grade levels among the students in the three groups were not considered an important experimental fac-

tor. Inequalities of the three groups will be indicated later

Measures secured from the subjects in each group included their scores on the Kuhlman - Anderson Intelligence Test; on the Unit Scale of Aptitude; on the Cooperative Achievement Test in Biology, and on weekly teacher-made, objective tests, and a teacher-made, objective final examination. The tests and final examination were patterned after the Co-operative test.

The intelligence, aptitude, and standardized achievement tests were administered by the principal of the school. One form of the Co-operative Test was given at the beginning and another form at the end of the experimental period. The weekly teacher-made tests were given by the teacher to cover the material taught each week. The final test was given one week after the end of the nine weeks of instructions.

Additional items of information secured for each subject were recorded on a mimeographed sheet containing blanks in which the teacher recorded his estimate of each student's preparation for each day's assignment and the student's attendance or absence. This sheet was filled out at the end of each class period. The teacher's estimate of preparation was based on the student's responses, workbook exercises, and the like.

Results and Interpretations

THE DATA secured from each of the three groups will now be presented and interpreted.

First, it is important to consider the relative basic capacities of the three unselected groups. Data showing important differences are presented in Table I.

Table I

Showing Mean I.Q. and Aptitude Index of Each Group

Group	Mean I.Q.	Mean Aptitude
N	101.79	95.47
P	98.04	91.87
F	95.61	91.95

The table reveals that Group N was superior to Groups P and F in both the capacities tested. It also reveals that Group F was inferior in intelligence and about equal in special aptitude to Group P. On the basis of these data, it might be inferred that Group N should excel Groups P and F in achievement in biology. Certainly, the differences suggest that some means should be employed to determine the effects of intelligence and special aptitude on the achievement scores.

Let us now study the means of the three groups derived from scores made on the teacher-made final examination and weekly tests. The average scores made by each group on the teacher-made final examination and weekly tests are presented in Table II.

Table II

Means and Difference Reliabilities Based on Final Examination and Weekly Test Scores

Group	Mean	S.D.	Mean	S.D.
N	46.15	1.46	67.50	1.91
P	44.34	1.48	66.33	1.97
F	47.57	1.67	75.00	2.44

D	N-F	P-F	N-P	N-F	P-F	N-P
d	2.96	6.76	4.81	10.87	13.33	2.98

THE DATA obtained from both sets of measures reveal that Group F excelled Groups N and P, and that the differences are statisticaly reliable. They show, on the other hand, that Group N excelled Group P. These facts suggest, of course, that the full visual aids program of instruction was more effective than either the non- or partial-visual aids program; and that the non-visual aids program was more effective than the partial visual aids program of instructions.

Since the three groups of subjects were unequal in intelligence and aptitude, it seemed desirable to determine what the mean of each group would have been if each student had had an I. Q. and an aptitude index of 100. This was done by dividing the achievement scores by the intelligence and aptitude scores and multiplying the ratios by 100. The re-

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Projects for Pupils in High School Chemistry

M. J. W. PHILLIPS

West Allis High School — West Allis, Wisconsin

TEACHERS of chemistry often hope for some activity through which the pupil could feel that he is making a contribution to the class — a "built-at-home" project brought into the class room from which the pupil can recite. The interest of the class is developed as other pupils inquire what they may do. To help the teacher who is looking for this type of material, here are some "pupil-built-at-home" projects suitable for the high school chemistry student.

Project I.

"Making Sulphuric Acid by the Contact Process" (see frontispiece), using iron oxide and steel wool as a catalyst instead of the expensive platinized asbestos.

The chamber containing the catalyst consists of a short length of one and one-half inch iron pipe. The boy doing this project welded the outlet end shut with a steel plate, then drilled and tapped it for a one-fourth inch pipe nipple. The open end or inlet end has four loops or pieces with holes for stove bolts welded on the sides of the one and one-half inch pipe. Four holes are drilled through the end plate which is held in place with the stove bolts. The opening between the plate and the pipe is fitted with a piece of automobile cylinder head gasket to make a tight fit. This bolted-on end is used to fill the catalysing chamber with a charge of iron oxide and steel wool. This plate is drilled and tapped for a one-fourth inch pipe nipple to which is attached a five-cent funnel placed over a dish of burning sulphur.

THE CONDENSER is made also of a length of one and one-half inch iron pipe through which runs a one-fourth inch pipe. All of this is welded together. One-fourth inch pipe nipples are placed in the sides of the condenser near each end through which cold water can circulate to cool the one-fourth inch iron pipe running through the condenser. The end of this one-fourth inch iron pipe is fitted to exhaust into an Erlenmeyer flask containing concentrated sulphuric acid and connected to an aspirator.

The operation is as follows: sulphur burning in the porcelain dish under the funnel produces sulphur dioxide. This sulphur dioxide mixed with air contain-

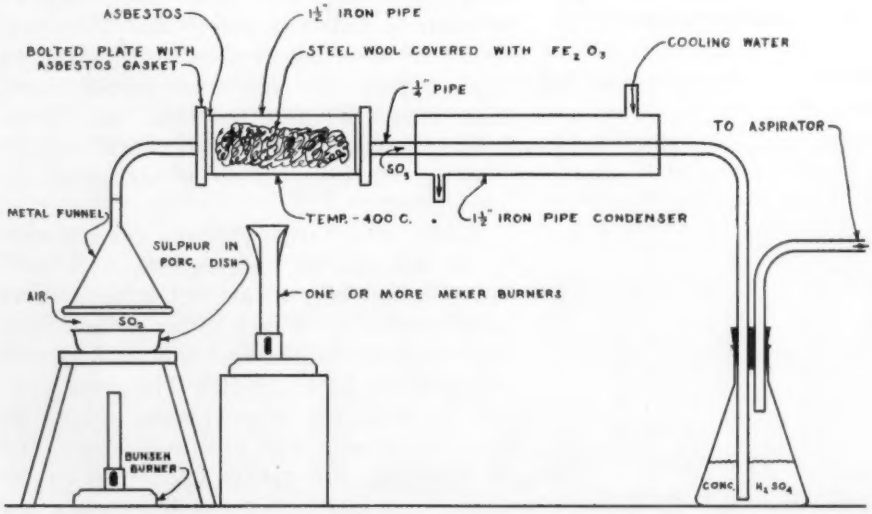


Fig. 1. Contact process for making sulfuric acid. For a picture of the apparatus see our Frontispiece.

ing the necessary oxygen is drawn up into the catalysing chamber containing the iron oxide, ferric ovide, and steel wool. This chamber is heated to four hundred degrees Centigrade. At this temperature the oxygen of the air drawn in with this sulphur dioxide combines with the sulphur dioxide to produce sulphur trioxide. This sulphur trioxide is drawn into the condenser where it is cooled into a liquid and drawn into the concentrated sulphuric acid in the Erlenmeyer flask. Sulphur trioxide is soluble in concentrated sulphuric acid, producing fuming sulphuric acid or oleum, to which can be added distilled water, thus producing concentrated sulphuric acid.

WHEN THE apparatus is connected to an aspirator and set in operation, its action can be traced, as shown in Fig. 1.

Sulphur trioxide is a liquid at forty degrees Centigrade and freezes into a solid at fifteen degrees Centigrade. To prove the existence of sulphur trioxide, the boy who did this project placed a "U" tube in dry ice and acetone as shown in Figure II, instead of the Erlenmeyer flask containing the concentrated sulphuric acid. The sulphur trioxide forms a snow-like solid in the "U" tube. Solid sulphur trioxide will combine very readily with water, in fact with explosive violence, forming sulphuric acid. He then showed the existence of the sulphate ion of sulphuric acid with barium chloride, getting a white precipitate, which persists or is insoluble in dilute hydrochloric acid or in dilute nitric acid.

It is not necessary to use dry ice and acetone to solidify sulphur trioxide. It

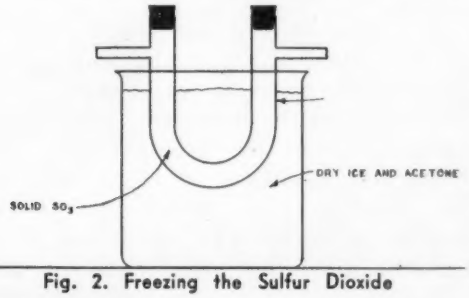


Fig. 2. Freezing the Sulfur Dioxide

Fig. 3. Making Charcoal Blocks

will solidify at the temperature of ordinary ice or a freezing mixture of salt and ice.

THE MIXTURE of dry ice and acetone in which is immersed a "U" tube can be used however to liquify and solidify many of the gases produced in high-school chemistry, such as sulphur dioxide, ammonia, chlorine, bromine, etc. This mixture is a very effective way to demonstrate liquid and solid states of many substances; if ether is added, a lower temperature may be obtained.

Pupil ingenuity could be called into play in this project. This apparatus could be made of standard one and one-half inch pipe nipples and pipe caps to fit on the ends so it might be screwed together instead of welded. Other catalysts could be tried, such as vanadium pentoxide. Recently, certain complex vanadium silicates have been employed as contact catalysts.

Give one of your students a project such as this. When it is completed, al-

(Continued on page 30)

Science for Society

EDITED BY JOSEPH SINGERMAN

● A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

The Scientist and the Consumer

D. E. MONTGOMERY
Consumers' Counsel
U. S. Department of Agriculture Washington, D. C.

CONFUSION for the consumer, due to lack of simple, accurate, and comparative information about goods, becomes worse confounded by the baffling, bewildering information that is given to him. Here, for example, are names that have been used to identify textile finishes — bellmanizing, martinizing, sanforizing, superizing, duralizing, tebilizing, sheltonizing, vitalizing, warconizing, salnizing, aqua-sec, and slip-naught. For many commodities quality grades have been established, and sometimes the consumer can find out what grade a product falls in. But note the bewildering way terms are used to designate first, second, or third grade and so on. For example, of 56 commodities on which the term "Grade A" is used, it represents first grade only 45 times. It is second grade for seven commodities, third grade for two, fifth grade for one, and sixth grade for one. Out of 80 cases in which the term "Grade 1" or "First Grade" is used, it is actually top grade for the commodities in question only 42 times.

TO COMPLETE this picture of consumer confusion cultivated by chaotic distribution methods, let me cite the classic tomato juice example. A consumer went into a Washington retail store last spring and purchased one each of every package of tomato juice the store carried. She came out with 21 packages, all different. In the lot there were 11 different brand names, packages of 17 different sizes by cubic content and 15 different sizes by net weight. They were purchased at 15 different prices. No two packages were identical as to size, content and price. Cost to the consumer for 10 ounces of tomato juice ranged from 3.3 cents to 7.5 cents. Only one package carried a quality designation. It was labeled Grade A, and incidentaaly was the cheapest of the lot, 3.5 cents for 10 ounces. A wise and economical consumer confronted with this array would need a slide rule to know how to buy. I'll wager not one storekeeper in a hundred could compute for this consumer which of these tomato juices cost more than another, and not that one in hundred could tell her about their comparative quality because only one of the twenty-one had been graded and labeled according to an objective standard.

I HAVE given time to this aspect of the consumer problem because it is in this field of consumer protection the scientist can be of most help. As you know, consumer have set up their testing and rating services which dig into one commodity line after another, buy samples, pull them apart, and try to tell consumers how the rival products compare. That is a field for science in the service of consumers. Indeed, these agencies could not operate if it were not for the generous assistance many individual scientists are giving to their work.

But stop here a moment to get the picture. Here is science at work pulling these goods apart to get at their secrets. Discovery of the unknown is always the great labor of the scientist. But here, mind you, scientists are using their skill to discover facts which are already known to those who made the goods. Science made the production of these

goods possible. The businessman takes what the scientist has told him, makes the goods, and then sells them so unscientifically that it takes other scientists to find out what they are good for. Take it all in all, I doubt you can find a greater perversion of human wisdom.

Such scientific sleuthing of finished consumer goods obviously is not the ultimate answer. What is necessary is that the distribution process be modernized to keep step with the great strides that have been taken in production. Distribution must be made scientific. The voodoo cult of merchandising by which makers and vendors of goods trade upon ignorance and superstition to hypnotize their customers and fill them with the spirit of divine acquiescence does not now serve the purposes of modern productive machinery and will not much longer meet the demands of today's consumers. Nor will it allow us to achieve that sustained, ever-increasing flow of goods which is imperative if we are to hold together this wagon in which we are all riding.

CHIEF REQUISITE of a civilized distributive system is a language by which consumer goods may be described. This language must provide objective descriptions of quality characteristics applicable to all goods of a given class so that all may be compared. It must reduce these characteristics to simplest possible terms consistent with the state of the productive process and with the state of scientific knowledge as to factors determining the utility of the goods in question. This language will enable us to establish a system of comparative quality grades for the labels on consumer goods, expressed in terms or symbols of such simplicity that the lay as well as the skilled consumer can recognize them and relate them to his buying and using experience.

Here is a great scientific task in the service of the consumer. The development of quality standards for consumer goods will require us to know a great deal more about such goods than we know today. We must find out how the utilities of various goods serve the purposes of different consumers; how the characteristics of content or construction determine those utilities; how they can be measured and described; how they can be sampled and tested and labeled in advance of sale. Then the practical people will have to be brought in to get their agreement on how this knowledge of goods can best be applied in practice. At that stage we had better call in some consumer leaders who know what is needed; otherwise consumers may continue to receive a great deal of advice and mighty little help.

I DOUBT that the scientist can launch this program. But if there is such a thing as a recognized obligation of scientific bodies to perform one good collective deed a year in the public interest, there isn't any greater contribution to human welfare they could make. Probably government will have to start this commodity research program on its way, though I see no present reason to hope that it will. Whoever starts it, the services of all who can take part will be required — scientists in private laboratories and industrial laboratories, in the colleges and in government.

To sum up in a sentence, my word to you is, we can produce abundantly, but we do not, because we do not know how to distribute what we produce, and the prime remedy which the scientist can apply to that dilemma is to create for us a language of practical commodity standards that will do for distribution what science has been doing so long and so well for the processes of production.

WANTED FOR PUBLICATION

We desire more articles for publication that give material of immediate use to science teachers such as demonstrations, methods of presenting certain units of subject matter, assembly programs, activities, etc. Write to us concerning what you may have or what you propose.

Science Clubs at Work

EDITED BY KARL F. OERLEIN

State Teachers College California, Pennsylvania

A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

Missouri Junior Academy of Science

E. M. J. LONG

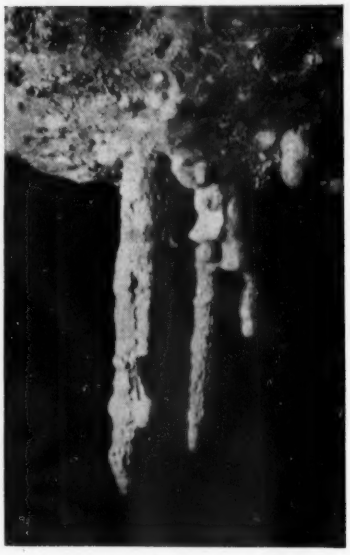
Normandy High School St. Louis, Missouri

For the material in this issue we are indebted to Ernestine M. J. Long, chairman of Missouri Junior Academy of Science. In the next issue the West Virginia Junior Academy of Science will be presented by Jack Neely of the Ansted High School, W. Va.— Editor.

THE MISSOURI Junior Academy of Science came into being about a year after the St. Louis Junior Academy of Science was organized. Dean W. D. Shipton, of Washington University, St. Louis, and Wendel F. Shay, of Normandy High School, St. Louis, were active in organizing the St. Louis Junior Academy. These men, with Dr. R. T. Dufford of the University of Missouri and Dr. R. A. Rogers of Parks College, the following year helped organize the Missouri Junior Academy of Science. The untimely death of Mr. Shay left the work largely in the hands of Ernestine M. J. Long of Normandy High School, St. Louis. She has continued as chairman.

The Missouri Junior Academy of Science is sponsored by the Missouri Academy of Science which in turn is affiliated with the American Association for the Advancement of Science. The Junior Academy is accountable to the Executive Committee of the Academy of Science of which Dr. R. T. Dufford is secretary.

The chairman is appointed by the Executive Committee of the Missouri Academy and in turn appoints a Committee on Junior Academy. The Committee greatly aids in the supervision of sectional meetings held twice yearly in various sections of the state.



Stalagmite in Cathedral Cave
Photographed by Academy Member

Committee on Junior Academy

Ernestine M. J. Long, chairman, Normandy High School, St. Louis.

Professor Willia Bray, State Teachers College, Kirksville.

Dr. John H. Harty, State Teachers College, Cape Girardeau.

Dr. Herald C. Hunt, Superintendent of Schools, Kansas City, Missouri.

Dr. Laura J. Nahm, Junior College, Flat River.

Dean W. D. Shipton, Washington University, St. Louis.

Dr. Ralph K. Watkins, University of Missouri, Columbia.

Dr. Byron Westfall, State Teachers College, Warrensburg.

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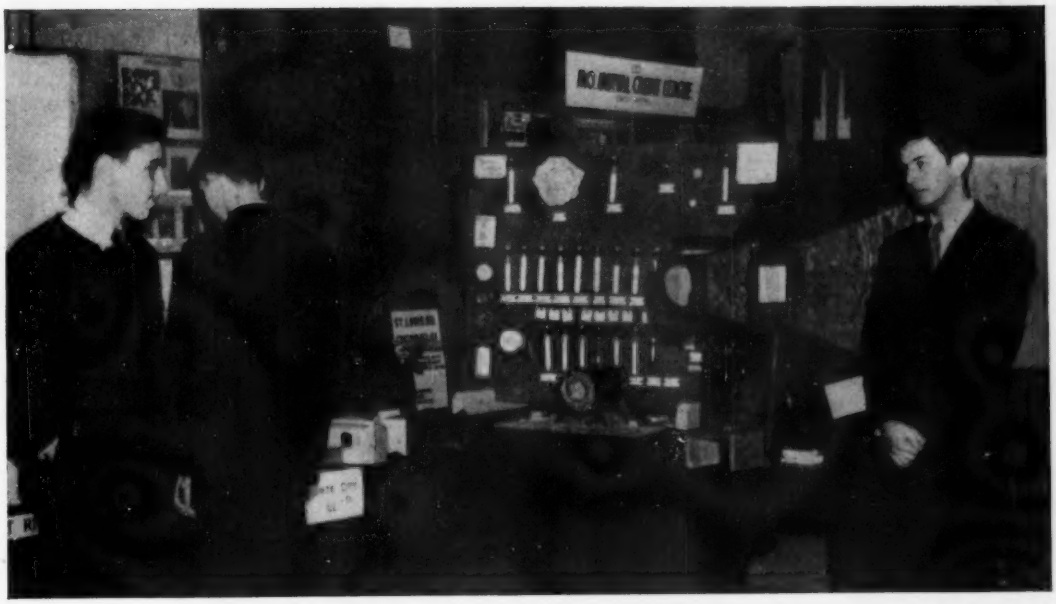


Sulfur Analysis of Gasoline

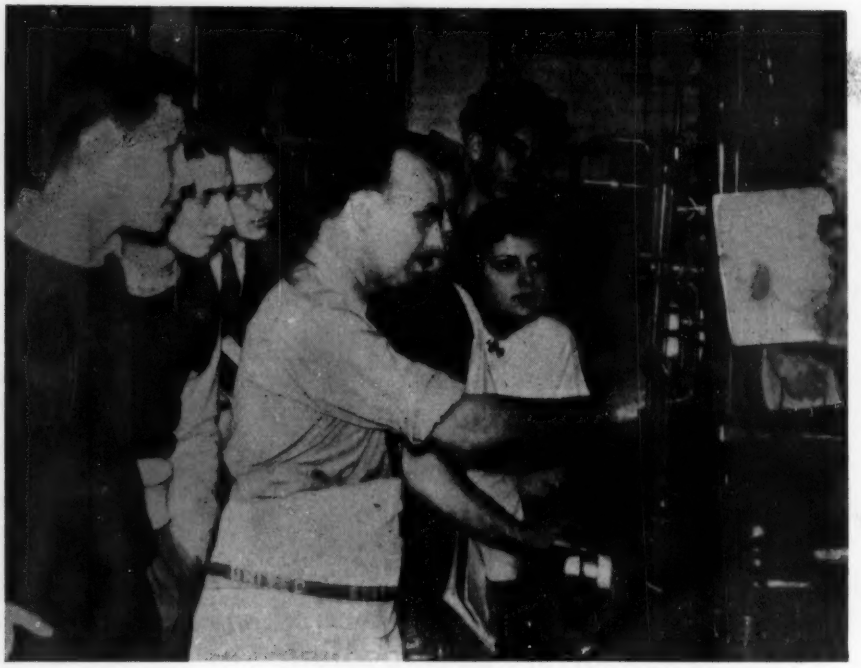
C. D. BUTLER
Student
Sikeston High School
Sikeston, Missouri

OUR SCIENCE club, the Sikeston Science Society, is working on the project system, with members working alone or in pairs on projects of their own choice. Some of the members read, in the Popular Science magazine, how to test the sulfur content of gasoline. Since sulfur will combine with moisture in the crankcase to form sulfuric acid, which in turn attacks vital engine parts and forms sludge in the oil, John Todt and C. D. Butler, members of the club, decided that they would find out how much sulfur the various gasolines sold in Sikeston did contain. As a result of their interest in this, they selected it as their project and performed the experiment outlined here.

A gasoline lamp was made by filling a 50 cc Erlemeyer flask one-third full of gasoline and making a wick from twisted cloth. The wick was pulled through a glass tube in a stopper and put in the lamp with the end in the gasoline. By use of an aspirator and a funnel, the fumes from the gasoline were pulled through into a U-Tube in which were a few glass beads and a ten per cent solution of sodium carbonate in the bend of the tube. By burning the lamp and collecting the fumes of the different gasolines for a set length of time, and by regulating the wick to a certain height, $\frac{3}{8}''$ to $\frac{1}{2}''$, before the fumes were collected, the analysis of the several gasolines can be made quantitative on a comparative basis.

IN THE experiments in our laboratory, we burned each gasoline for 25 minutes and were able to compare the results. If sulfur was in the gasoline being burned, sulfur dioxide fumes were given off and were dissolved in the sodium carbonate to form sodium sulfite. The solution was taken from the U-Tube and poured into a test tube. Drops of hydrochloric acid were added until the solu-

(Continued on page 38)



Trip through U. S. Pure Food Laboratories. To the left is Norbert Roesel, first vice president of the Missouri Junior Academy of Science.

Products From Milk

GERALD PERKOFF
Student
Normandy High School
St. Louis, Missouri

A GREAT number of things can be made from milk that will involve a use of chemistry. Among these things are plastics, paint and glue. In the present experiments milk and powdered casein were used.

In the first experiment casein was separated from milk with rennet tablets One quart of milk with two rennet tablets was heated at body temperature for thirty minutes. The curd was removed and allowed to stand. The first difficulty came when the molds began to grow on the drying curd. They were removed by scraping, but the casein was sticky and would not powder well.

Ready powdered casein was obtained. This dust smelled like vanilla ice cream or boullion soup. The casein was dissolved in water containing sodium carbonate to 5% of its weight. The casein was partly precipitated by the use of hydrochloric acid. The solution was next made alkaline with sodium hydroxide to remove all color. The resulting product was run through a suction filter which was connected to the tap by a hose to create a partial vacuum to draw the water through more quickly. Here a difficulty was encountered, because the filter paper broke. It was necessary to get a heavier filter paper from the Coca-Cola Bottling Co. The casein obtained was treated with formaldehyde and placed in a mold to harden. Color was added at the time the formaldehyde was mixed with the casein. After five days the hard material was shaped up on a rotary grindstone and buffer polishing was done on a water run motor.

THE GREATEST difficulty is the manner in which the material shrinks when

(Continued on page 38)

Dust Precipitation

DAN COTNER
Student
Central High School St. Louis, Missouri

OVER A quarter of a century ago, Cottrell showed western copper smelters how they could precipitate the solid particles of dust in smokestacks by passing them between heavily charged plates. To charge these plates in those days was quite a problem, for high-voltage direct current had to be used. This was unheard of, so Cottrell used high-voltage alternating current with a rotary spark-gap and a synchronous motor. The result was a costly, messy job but it saved law suits from being filed by the farmers whose fields were being sprinkled with tons of dust. The model to be presented works on the same principle as the original, but is modified because of equipment and presentation.

Electrical precipitation can be performed on both dust and smoke. A colloidal smoke can be used for convenience. Compressed air was forced through a flask containing ammonium hydroxide and then into a flask of hydrochloric acid. As a result of neutralization, ammonium chloride and water was formed. The gas, being heavier than air, was forced out of the pipe by the compressed air.

$$NH_4OH + HCl \rightarrow NH_4Cl + H_2O$$

Electricity necessary for the precipitation was produced by passing seventeen volts of alternating current through a coil. The vibrator produced a form of direct current. There was an attraction of the oppositely charged particles of smoke and in this way practically all of it was deposited.

Experimentation has shown that a metal pipe was more satisfactory than a glass one with wire in it. When using a glass pipe, screen wire was wrapped on the inside, the glass providing too good an insulator for the wire to be on the outside.

Several electrodes were tried, the best being a brass welding rod. This must be cleaned periodically. Dust and corrosion slowed up the operation. Other electrodes used were patented alloy containing much iron and a copper plated steel welding rod.

A SYSTEM of Cottrell precipitation is now used at the local cement plant at Cape Girardeau, Missouri. Four hundred forty volts are used on the primary windings of the transformers. This voltage is varied inversely as the dampness of the material to be precipitated. The ratio of the transformer is 136 to 1, therefore the secondary voltage is 60,000. The rotary spark-gap is operated by a synchronized motor. When a motor is started and is not synchronized, a relay cuts off the current and a warning is sounded. The reversible switch is thrown in the opposite direction and the motor is now synchronized with the generator. The rotary spark wheel changes the alternating current to a form of direct current. To omit controversy we shall call it static electricity.

The precipitation compartment was filled with a network of electrodes, the discharge rods running horizontally and the charge rods running vertically. Five inches was the approximate spark gap. Thes electrodes were of a patented alloy and were very expensive.

Two hundred forty rods of each charge were used in a section, the company using six sections. A unit, consisting of a synchronous breaker and a transformer, operated in two sections.

Precipitation on the vertical or charging rods was removed by using a pneumatic hammer on the caps. A small amount of dust was deposited on the discharge rods and these were occasionally shaken.

(Continued on page 39)

Books for the Biology Library*

LYLE E. BAMBER
Natural History Librarian
University of Illinois Urbana, Illinois

IN CONSIDERING the books which should be recommended for a high school library as suitable reference and reading books in biology, we must have clearly in mind the purposes of a biology course, the types of books needed to fulfill these purposes, and the requirements the books should meet to answer these specific needs.

A high school biology course should have at least the following aims:

1. Give the student a speaking acquaintance with the living things he finds all about him, how they grow and reproduce, and carry on various other life processes.

2. Impress on the student the orderliness of nature through an introduction to classification.

3. Stress the idea of the balance of nature and the associated present-day problem of conservation.

4. Acquaint the student with the various fields of biology, their relation to various professions, and their possibities either as a life work or as an avocation.

5. Give the student a broad view of the history of biology by a study of the lives of outstanding workers.

6. Teach the use of the scientific method and how it may be applied to everyday problems.

The books selected for reference and outside reading should meet the following requirements:

1. **Authoritativeness.** — The .author should be one qualified to write on the subject and the facts given must be accurate.

2. **Readability.**— For a high school student this means nontechnical language and interesting style.

3. **Attractive physical make-up.** The book should be well and attractively bound, printed on good paper in clear and not too small type, and be well illustrated.

THE TYPES of books needed fall into two general classes, semitechnical and nontechnical. The more able students will push their inquiries into the adult level, and teachers will need the library for their salvation when the limits of their knowledge begin to be pressed.

The books listed below have been selected to fit into a definite plan which will answer the aims mentioned previously. These may not be the best books but they are offered as a suggested nucleus for a biology library and represent the various phases of the subject in the best possible manner.

History of Biology

Locy, William Albert. Biology and its makers. New York, Henry Holt and Company, 1928. 3rd ed. $3.00.

Peattie, Donald Culross. Green laurels; the lives and achievements of the great naturalists. New York, Simon and Schuster, 1936. $3.75.

Snyder, Emily Eveleth. Biology in the making. New York, McGraw-Hill Book Company, 1940. $2.80.

Early Man

Cole, Mabel Elizabeth (Cook) and Cole, Fay-Cooper. The story of man, his earliest appearance and development to the portals of history. Chicago, University of Knowledge Inc., 1938 (University of Knowledge Series. Glenn Frank, editor-in-chief). $3.00. (Also cheaper edition).

Quennell, Mrs. Marjorie (Courtney) and Quennell, Charles Henry Bourne. Everyday life in the new stone, bronze

* This paper is based on a talk delivered before the Biology Section of the Thirty-Sixth Annual High School Conference held at the University of Illinois, Urbana, November 1, 1940.

and early iron ages. New York, Putnam, 1931. 2nd ed., rev. (Everyday life ser.) $2.50.

Quennell, Mrs. Marjorie (Courtney) and Quennell, Charles Henry Bourne. Everyday life in the old stone age. New York, Putnam, 1922. (Everyday life ser.) $2.50.

General Biology

a. Nature study and hobbies.

Comstock, Anna (Botsford). Handbook of nature-study. Ithaca, N. Y., Comstock Publishing Co., 1939. 24th ed. rev. $4.00.

Innes, William Thornton. Complete aquarium book; the care and breeding of goldfish and tropical fish. New York, Blue Ribbon Books, 1936. $1.89.

Peattie, Donald Culross. Flowering earth wood engravings by Paul Landacre. New York, G. P. Putnam's sons, 1939. $2.50.

b. Use of the microscope.

Disraeli, Robert. Seeing the unseen; with photomicrographs by the author. New York, Day, 1939. New rev. ed. $2.50. (Educ. ed. $1.88.)

Yates, Raymond Frances. Exploring with the microscope. New York, Appleton-Century, 1934. $2.00.

Plant Life

a. Classification.

Gray, Asa. New manual of botany; a handbook of the flowering plants and ferns of the central and northeastern U. S. and adjacent Canada. New York, American Book Co. 1908. 7th ed. $3.00.

Clute, Willard Nelson. Common names of plants and their meanings. Indianapolis, W. N. Clute & Co., 1931. $3.00.

Clute, Willard Nelson. Second book of plant names and their meanings. Indianapolis, W. N. Clute & Co., 1939. $3.00.

Durand, Herbert. Field book of common ferns for identifying fifty conspicuous species of eastern America, with directions for their culture. New York, Putnam's, 1928. (Putnam's nature field books.) $2.50.

Thomas, William Sturges. Field book of common mushrooms. New York, Putnam, 1936. 2nd enl. ed. $2.50.

Free, Montague. Flowers of winter, indoor and out. New York, Doubleday, 1917. (Pocket garden library.) $1.50.

Harvey, June. Wild flowers of America. Racine, Wis., Whitman Pub. Co. 10 cents.

House, Homer Doliver. Wild flowers. New York, Macmillan, 1936. Imperial ed. $3.95.

National Geographic Society. Book of wild flowers; an introduction to the ways of plant life. Washington, D. C., The Society, 1933. 2nd ed. $3.00.

Mathews, Ferdinand Schuyler. Field book of American trees and shrubs. New York, Putnam, 1915. $3.50.

Rogers, Julia Ellen. Tree book. New York, Doubleday, 1914. (New nature library, v. 3, pt. 1.) $3.25.

b. Plants of local community and state.

Illinois — Natural History Survey. Fieldbook of Illinois Wild Flowers. Urbana, Ill., The State of Illinois, 1936. $1.00.

Miller, Robert Barclay, and Tehon, L. R. The native and naturalized trees of Illinois. Urbana, Illinois, State of Illinois, 1929. (Ill. Nat. Hist. Sur. Bull. v. 17, no. 1) P. P.

c. Beneficial and Harmful Plants.

Conn, Herbert William. Bacteria, yeasts and molds in the home. New York, Ginn, 1932. 3rd rev. ed. $1.60.

Park, William Hallock, and Williams, Anna Wessels. Who's who among the microbes. New York, Appleton-Century, 1929. $3.00.

Medsger, Oliver Perry. Edible wild plants. New York, Macmillan, 1939. $3.50.

McDougall, Walter Byron. Mushrooms; a handbook of edible and inedible species. Boston & New York, Houghton Mifflin Co., 1933. New ed. $3.50.

Muenscher, Walter Conrad Leopold. Poisonous plants of the United States. New York, Macmillan, 1939. (Rural science ser.) $3.50.

Program

IOWA ASSOCIATION OF SCIENCE TEACHERS

The Iowa State College, Ames, Iowa, February 28, 1942

Chairman: Delma Harding, Newton High School

9:00 Registration

10:00 Class Visitation

11:00 Demonstration Techniques — Dr. Dietz and Dr. Brown

12:00 Noon — Luncheon
Welcome — Dean H. V. Gaskill
Address — "The Science Teacher in the National Emergency," Dr. Melhus

1:45 Demonstration Lectures:
Photography — Dr. Carr
Microscope and Slide Making — Dr. Sass
Entomology and Bird Study — Dr. Harris
Gas Warfare — Dr. Sweeny

Saunders, Charles Francis. Useful wild plants of the U. S. and Canada. New York, McBride, 1934. 3rd ed. rev. & enl. $3.00.

Muenscher, Walter Conrad Leopold. Weeds. New York, Macmillan, 1935. (Rural science ser.) $6.00.

Animal Life

a. Classification.

Comstock, John Henry and Comstock, Anna Botsford. How to know the butterflies. New York, Appleton, 1915. $3.50.

Comstock, John Henry; Comstock, Mrs. Anna (Botsford), and Herrick, Glenn, Washington. Manual for the study of insects. Ithaca, N. Y., Comstock Pub. Co., 1938. 22nd ed. rev. $4.00.

Lutz, Frank Eugene. Field book of insects. New York, Putnam, 1935. 3rd ed. (Putnam's nature field books.) $3.50.

National Geographic Society. Our insect friends and foes and spiders. Washington, D. C., The Society, 1935. $2.50.

Fazzini, Lillian Davids. Butterflies and moths of America. Racine, Wis., Whitman Pub. Co. 10 cents.

Morgan, Ann Haven. Field book of ponds and streams. New York, Putnam's, 1930. (Putnam's nature field books.) $3.50.

National Geographic Society. Book of fishes. Washington, D. C., The Society, 1939. Rev. and enl. ed. $3.50.

Conant, Roger, and Bridges, Wiliam. What snake is that? New York, Appleton-Century, 1939. $2.00.

Ditmars, Raymond Lee. Reptiles of North America. New York, Doubleday, 1936. New rev. ed. $6.75.

Chapman, Frank M. Bird-life. New York, Appleton-Century, 1924. $5.00.

Chapman, Frank M. Color key to North American birds. New York, Appleton-Century, 1912. Rev. ed. $4.00.

Peterson, Roger Tory. A field guide to the birds. Boston, Houghton Mifflin, 1939. Rev. and enl. ed. $2.75.

Ashbrook, Frank G. Bird guide series. Racine, Wis., Whitman Pub. Co., 1931. 10 cents.

Anthony, Harold Elmer. Field book of North American Mammals. New York, Putnam, 1928. (Putnam's nature field books.) $5.00.

b. Local animals.

Cory, Charles B. The birds of Illinois and Wisconsin. Chicago, Field Museum of Nat. Hist., 1909. (Field Museum of Natural History. Zool Ser. v. 9.) $4.50.

(Continued on page 37)

Projects for Physic

NELLIE F. BATES

Champaign High School

Champaign, Illinois

"ARE WE going to make projects this year as the physics students did last year?" It was the first day of school and already this boy was eager to get started on something he would enjoy doing.

The assignment is definitely made about the last of October as follows:

"You are to be given the opportunity to make a physics project or write a theme about some topic in which you particularly interested and about which you would like to learn more than can be taken up in the study of our text. This is done outside of class. This assignment is not compulsory, but one which you may choose to do. However, if you expect a grade of A or B the second quarter, you must hand in something.

AFTER TEN years, however, it has been my experience that only four or five out of approximately one hundred and twenty-five students fail each year to hand in something. The specific directions are given below:—

Directions for Term Themes

1. Choose a topic from the board (about fifty are listed)— or an original topic, with my approval by Friday, November 14. Hand in your name and topic at that time.

2. Your theme should be from 1500 to 2000 words long.

3. Use the same care and rules that you would for an English theme. Use a manila folder cover.

4. Illustrations, diagrams, and tables will make your theme interesting and attractive.

5. Sources of material must be listed in a bibliography.

6. Themes will not be accepted after January 12, but if handed in a week or more earlier they will receive extra credit.

Directions for Projects

1. Hand in the name of your project by November 14.

2. Neatness and originality count high.

3. Make a project from which you will learn something new.

4. Projects will not be accepted after January 12, but if handed in a week or more early, they will receive extra credit.

SOME OF the best themes received have centered around such topics as "Physics in the Kitchen," Physical Principles Used in Medicine and Dentistry," and "Physics of the Automobile." These themes are usually beautifully illustrated with pictures and diagrams. Such topics as the above require considerable originality because there are not books or articles written on them.

Some of the most popular projects received each year are airplanes, radios, and model stages. The latter are wired and color schemes are worked out. Sometimes original designs of airplanes have been handed in and those with movable controls are in especial favor.

The most remarkable project ever attempted was a mural painting covering the space above the blackboard across the front of the classroom. It illustrates the entire physics course from Measurements, with a portrait of Archimedes with his compass, through Light with a picture of the 100 inch telescope on Mount Wilson. It took the student from the first of November to the first of May 1938 to complete it, painting only in his spare time. He used oils and painted on the wall itself. It has been an inspiration and a real teaching aid ever since. Of course, one does not ofen have a student who is as talented as that boy happened to be.

SOMETIMES the projects grow out of the students' own needs or problems.

(Continued on page 35)

VISUAL INSTRUCTION

(Continued from page 15)

sults of these calculations are presented in Table III, which shows what the means of the three groups would have been if the subjects had all been of equal intelligence.

Table III

Achievement Scores of Three Groups Equated in Regard to Intelligence and Aptitude

	Final Examination "Equated Means"			Weekly Tests "Equated Means"		
Grp.	N	P	F	N	P	F
Int.	45.3	45.2	49.7	66.3	67.7	78.5
Apt.	70.7	72.3	81.6	70.7	72.3	81.6

THE DATA in Table III show an impressive superiority of Group F in achievement as measured by both sets of tests. Group P, however, fails to show a marked superiority. The facts imply, therefore, that the full visual aids program was more effective than either the non- or partial-visual aids program; and that the non-visual aids program was equaly as effective as the partial visual aids program.

The average scores made by each of the three groups on the Co-operative Achievement Test in Biology, given at the beginning and end of the experiment, are presented in Table IV, along with the gains in achievement made by each group.

Table IV

Showing Means, Gains in Means, and Percentages Gained by the Three Groups on a General Test in Biology

Gr.	Initial Test Mean	S.D.	Final Test Mean	S.D.	Amt. Gain	Pct. Gain
N	37.26	3.12	54.63	2.10	17.37	46.6
P	29.08	1.97	52.30	2.04	23.22	79.8
F	30.33	2.37	47.57	1.98	17.24	56.8

THE INITIAL and final means shown in the table reveal that Group N was superior to Groups P and F both at the beginning and end of the experiment. The per cents gained, however, show that the groups having visual aids made considerably greater gains. The gain of Group P was 33.2 per cent and that of Group F 10.2 per cent greater than the gains of Group N. These gains, it may be recalled, are gains over the general field of biology rather than over the units covered during the experimental periods. The data in Table IV, considered as a whole, indicate that Group N was a superior, Group P a mediocre group, and Group F an inferior group in biology during the entire period. The fact that the inferior groups excelled the superior group in the percentages of information gained seems to imply that the visual aids programs were particularly effective.

An effort will now be made to present and interpret the data secured from the teacher's daily record of pupil attendance and lesson preparation. The object of the records, it will be recalled, was to determine whether the programs of instruction would have different effects on these aspects of student behavior.

THE DATA secured from the records were converted into percentages showing the percentage of student days the students in each class were present and the percentage of student days those in each group made "adequate" and "inadequate" preparation. "Student days" are the total number of days covered by the experiment times the number of students in a particular group.

Percentages of attendance and of inadequate and adequate preparation are presented in Table V.

Table V

Percentages of Student Days of Attendance and of Inadequate and Adequate Lesson Preparation

Group	Attendance	Preparation	
	% of St. Days	Inadequate	Adequate
N	87.5	35.8	26.0
P	92.1	33.9	34.0
F	93.7	21.4	36.1

The table indicates that attendance and lesson preparation were better in Groups P and F than in Group N, both being superior in Group F. These facts suggest that the visual instruction pro-

(Continued on page 36)

MISSOURI JUNIOR ACADEMY

(Continued from page 20)

THE JUNIOR Academy of Science of St. Louis meets once a month. This group, comprising a section of the state, are under a group of science club sponsors who work with the St. Louis Academy of Science.

Each chapter elects officers and a cabinet representative. The cabinet transacts the business and nominates officers. Students under twenty-one years of age vote on policies at the annual meeting which is held in conjunction with the Senior Academy. If students really make discoveries, they present their papers before Senior Academy sections. The student officers for this year are. president, Warren Harter, High School, Flat River; vice-president, Russell Wilson, Sikeston; secretary-treasurer, Mary Dellande, Beaumonth High School, St. Louis.

At district meetings pupils present their own demonstrations, projects, exhibits and papers illustrating various types of activity. There are occasional outside speakers of note. The plan encourages students to create and make discoveries, stimulates research, increases poise and public speaking ability and the ability to think scientifically. At luncheon meetings groups become acquainted with prominent men of science and often get ideas from others about their investigations.

EXHIBITS of student work have been held at state teachers conventions; the state fair; at Stix Baer Fuller Company in St. Louis. Nine thousand people have viewed exhibits in a special salon and at annual and district meetings over the state. In the case of the Stix Baer exhibit, the display department set up a fresh window each day to command public attention. The store remained open one evening for a reception to which prominent people were invited.

Each year a girl and boy from the St. Louis area and from the state at large are nominated by chapters and elected through three committees of judges to honorary junior membership in the A.A.A.S. As a rule these boys and girls get college scholarships.

Every effort has been made to be of service to and inspire both sponsors and young people. The last two years pupils have written about their unusual projects. These were printed and sent to clubs; others have been sold for twenty-five cents each to help defray expenses. The second kit was really a compilation of what students were doing in five states.

THE STATE organization is now servicing forty-six chapters. The president, Warren Harter, of the Missouri Junior Academy, was asked to address the science teachers in a sectional meeting at Cape Girardeau this last fall. Warren uncovered an activity cycle in science teaching. He believes that you become interested in science by getting a book and digging it out yourself. Warren thinks the classroom-laboratory experience is an improvement over the self-help method; however, he also thinks that the science club is a refinement of the classroom-laboratory method. He does not feel that we should not study alone just because we have classrooms and laboratories. He would not do away with any of these features in the learning process. Warren believes that to do away with laboratories or science clubs would be to put science teaching in hoop skirts.

Washington University has given lecture demonstrations for members of the St. Louis Junior Academy. In one instance the students saw the new cyclotron. The University of Missouri gave a series of vocational guidance demonstrations at the annual meeting at Columbia last spring.

The Missouri Junior Academy of Science is dedicated to the advancement of science in Missouri, to motivating and encouraging the spirit of discovery among youth and to raise up strong future leaders for the nation.

PROJECTS IN CHEMISTRY

(Continued from page 17)

low him to present it to the class. You will see an increase in interest on the part of all members of the class. Other pupils will express a desire ot take part in this manner. Any activity that offers an opportunity for the pupils to get the materials of chemistry outside of the classroom or the school laboratory makes for better work in chemistry. It increases interest, improves attitude, and produces real work with a real contribution on the part of the pupil.

Project II.

"Making Charcoal Blocks Out of Wood" (Fig. III). For those pupils who find it difficult to do the more complicated project, such as "The Contact Process of Sulphuric Acid," this one is excellent. The equipment is an old coffee can with a tight-fitting cover. In the

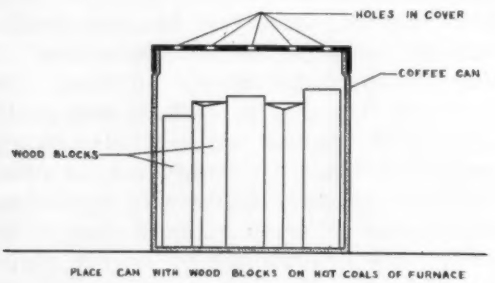


Fig. 4. Can for Making Charcoal.

cover are punched several holes to allow the products of destructive distillation to escape. The heat is supplied on the coals of the home furnace. The illustration, Figure IV, shows the can on the right filled with wood blocks, the size ordinarily used as charcoal blocks in the laboratory. This can is placed on the top of the coals in the furnace after the fire has been banked for the night. The can is taken out in the morning. The resulting charcoal blocks are seen at the left in the picture (Fig. III). Charcoal blocks for supplying your laboratory may be made in this way.

THE RESULTS with this project will be satisfactory if the can filled with the substances to be distilled is placed on not too hot a fire; rather, after the fire is banked for the night. The process carried out is more satisfactory than if it is hurried on a bed of red hot coals.

If the chemistry class happens to be studying carbon, you might designate a day called "carbon day." Appoint a chairman and have him designate to different members of the class the foods and other materials that could be sujected to destructive distillation by using this tin can equipment. Teachers and pupils will be surprised at the array of charcoals made from foods, fruits, candies, etc.

THE ACTIVITY is much more meaningful than the destructive distillation experiment in an ignition tube, test tube or clay pipe, under classroom or laboratory conditions. Allow or encourage your pupils to perform the experiment on destructive distillation using an old coffee can. It will lead to many interesting questions, and when a pupil has a question, he is in a position to learn. Such questions as "How is activated charcoal made?" What is it used for?" will arise in the ensuing discussion.

TRENDS IN SCIENCE TEACHING

(Continued from page 5)

to follow through with the reorganization of the science program.

When enough science teachers are convinced it is their task to plan the new science program, and really to do it, then we will have a new trend. If enough organizations or groups participate, we will be in position to consider some kind of a national organization in which all groups can work together. That is our greatest need now. Is it too much to expect that this will be the next trend?

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THREE INSECT PESTS

(Continued from page 13)

in about three weeks, then go down the trunks of the tree, enter the ground and there change to the next stage. After about two weeks in the soil the adult emerges and is soon ready to lay eggs for another group of worms. Two and sometimes three generations are produced each season, the last generation wintering in the resting stage beneath the ground, and producing moths the following spring.

Control: While these worms are large and very ravenous feeders, they may be controlled very easily by spraying or dusting. Spraying with arsenate of lead, at the rate of ½ pound to ten gallons of water, applying the spray as soon as any of the caterpillars are noticed on the leaves, will afford almost complete protection. As a dust, the powdered lead arsenate may be diluted with hydrated lime, using one part of the former to two parts of the latter.

ANY OF the derris dusts containing not less than 0.5 per cent rotenone are effective against the smaller caterpillars. This control is especially useful for the smaller umbrella-shaped catalpa, where not much of the material would be necessary and could be applied with a hand duster. The caterpillars cease feeding immediately and though they may cling to the leaves for several days, do no more damage.

The fall webworm is a native insect which is distributhed throughout most of the United States and parts of Canada. This caterpillar builds conspicuous and unsightly nests in many of our shade and forest trees. These nests may be exceedingly common during the latter part of the summer and early fall. The fall webworm is a yellowish caterpillar, with faint stripes running lengthwise, and is covered with long, whitish hairs. The insect is reported to attack 120 kinds of plants, including many broad-leaved fruit, forest, shade, and ornamental trees and shrubs. We may name the following trees as being commonly attacked -- walnut, elm, maple, oak, and hickory. In the southern states persimmon and pecan are favorite hostplants. The ability to feed and live on so many food plants is probably the most important factor in making the fall webworm a possible pest on shade and forest trees throughout most of the United States. The densely woven tents or webs in which the caterpillars live offer substantial protection against unfavorable weather and various enemies. On account of the dense hairy coat the caterpillars are protected against many insect-eating birds. Only a few birds find these hairy caterpillars suitable to their taste.

THE FALL webworm spends the winter as a pupa in a thin cocoon under loose bark or in a crevice of a tree, under rubbish, leaves, or stones on the ground, or even an inch or so in the soil.

The time that the moths appear the following spring varies from year to year and the period of emergence may extend over several weeks.

Usually the moths are pure white but some of them may have dark spots on the hind wings. The female has a wingspread of about 1½ inches. The males are slightly smaller.

The eggs are laid in clusters on the under side of the leaf of a food-plant. Usually the leaves toward the outer end of a twig are selected. Frequently the eggs are placed low and can be easily found. A cluster of eggs with its dense white covering of hairs from the female's body is somewhat conspicuous. Each egg is round, about 1/50 inch in diameter, and the surface is finely pitted or marked. They are yellowish when first laid, but before hatching turn to a dull lead color. Each cluster may have several hundred eggs.

THE FEMALE after depositing her cluster of eggs seems to have no desire to move and may remain near the eggs for four or five days, or until she dies. Sometimes the male is found with the female during egg deposition.

The eggs hatch in from 8 to 12 days. The young caterpillars move to the upper side of the leaf on which the eggs were laid, or of some nearby leaf, begin to feed and spin their tent or web. During the first week, or longer, these larvae are skeletonizers, consuming only the upper layers of the leaves. The older larvae eat the entire leaf, leaving only the midrib and larger veins. They feed mainly within the tent or web, and this structure is thus rapidly enlarged so that it may cover entirely a small tree, or entire branches of large trees. These tents are very unsightly in shade trees, containing as they do cast skins of caterpillars, dried excrement, etc.

The material of which these tents is made is excreted by the caterpillars and poured out through an opening in the lower lip. This material is at first a liquid but hardens soon after exposure to the air. Most caterpillars, as well as many other insects, are able to secrete this silky material, but not always in as large amounts as the fall webworm.

THE caterpillars become full grown in about 35 days. They are slow feeders and are therefore slow to become full grown. The mature caterpillar is about 1¼ to 1½ inches long. These full-grown caterpillars seek shelter as already described and enter the third or pupal stage.

There is not complete agreement among workers as to the number of generations of the fall webworm during the year. The general conclusion seems to be that throughout most of its range there is a single generation each year with at least a partial second in the extreme southern part of the country.

Control: Probably the best measure for the control of webworms is to destroy the nests as soon as they appear.

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When the webs are within reach of pruning tools they may be removed and burned, provided that removing the infested parts does not disfigure the tree. A torch made by tying oil-soaked rags to a pole is very useful, but must be applied with care, so that the trees will not be unduly scorched.

SPRAYING the trees with lead arsenate at the rate of ½ pound of the arsenical to 12 gallons of water will control the young caterpillars. It is difficult to kill with this spray caterpillars that are more than half grown.

Should more information be desired, refer to the bibliography which follows.

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(5) Howard, L. O. and Chittenden, F. H. 1916. The bagworm are injurious shade-tree insects. U.S.D.A., Far. Bul. 701.

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(9) ——— 1938. Important leaf feeding and gall making insects infesting Michigan's deciduous trees and shrubs. Michigan Agr. Exp. Sta., Spec. Bul. 243.

(10) Metcalf, C. L. and Flint, W. P. 1939 Destructive and useful insects. McGraw-Hill Book Co., New York.

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PROJECTS FOR PHYSICS

(Continued from page 27)

One boy liked to go to sleep with his radio playing, but his parents naturally objected to having it playing all night. He devised a way of having it automatically turned off by an alarm clock at 10:30 each night. Another boy, who lived in the country, wanted to know when the mail had been delivered without having to run out to see, so he made an electrically wired mail box which, when the lid was lifted, would cause a door bell in the house to ring. One boy ground his own lens for a telescope he was constructing.

Posters are interesting projects. One boy drew one which illustrated the physical principles in football. He was somewhat of a cartoonist and his football characters were comically illustrating "momentum," "action," and reaction," Newton's second law of motion, etc.

AFTER THE projects are all in and graded, an exhibit is set up in the library where there is plenty of display space up on top of the shelves and where the entire student body may see. Each project is carefully labelled so that all may know what it is illustrating and who made it. The airplanes are suspended by fine wires near the ceiling so that no one may touch them. This attracts a great deal of attention and does more to advertise the course than anything else could do. When Susie finds that Mary made a radio that really works, she may be inspired to want to take the course, too. One evening after school, during the week of the exhibit, is set aside as demonstration day. The student body and parents are especially invited in to see the projects operated and explained by their proud owners. The parents are just as much interested as the students.

(Continued on page 40)

VISUAL INSTRUCTION

(Continued from page 28)

grams were more interesting to the students than was the traditional program. Both measures are affected by other factors than interest, of course, but it is altogether possible that the interest factor was greater in the experimental groups than in the control group. Further evidence of this observation is the testimony of the teacher, who reported that the students having visual aids were considerably more interested in the study of biology than were those having no visual aids. Thus it appears that one of the chief values of the visual instruction programs was the effect of increasing the interest of the students and more thorough preparation of daily assignments.

Summary

THREE groups of subjects were taught by varying amounts of visual instruction. Group N had no visual aids of the projection type. Group P had still projection aids, including lantern slides and film slides. Group F had both still and moving projection aids, including lantern slides, film slides, and selected silent and sound movies. Other than the use of visual aids, the three groups were taught in essentially the same manner by the same teacher.

Group N was superior to Groups P and F both in intelligence and special scholastic aptitude. In spite of these differences, it was found that:

1. Group F excelled Group N on teacher-made weekly tests and a final examination, thus indicating superior effects of the full visual aids program.

2. Group P made scores on the weekly tests and final examination about equal to those of Group N.

3. When the three groups are equated in respect to intelligence and special scholastic aptitude, the ahievement of both visual aids groups is superior or equal to that of the non-visual aids group.

4. Group N excelled Group P and F on a standardized test in biology given at the beginning and end of the experiment, but Groups P and F excelled Group N in the percentages of gain on this general test.

g. The experimental groups attended class more regularly and prepared assignments more often than did the control group.

All of these findings suggest a very definite superiority of the visual instruction programs over the non-visual instruction program employed in the experiment.

AMERICAN SCIENCE TEACHERS

(Continued from page 6)

b. To encourage local organizations of science teachers to cooperate actively in harmonious activities with each other.
c. To encourage and help science teachers, where organized groups are nonexistent or inactive, to organize for the study of their local problems.
d. To provide opportunities for mutual acquaintanceship of science teachers from different organizations of science teachers.
e. To foster a spirit of good fellowship and friendship among science teachers.
f. To promote among administrators understanding and acceptance of the aims and objectives of this organization.

Section 3. The objectives which this association shall endeavor to encourage are as follows:

a. A national policy of science education.
b. A spirit of professionalism among science teachers.
c. The publication and dissemination of research results and other materials of interest and value to science teachers.
d. A general acceptance and use of science objectives by teachers, administrators, and the general public.
e. An adequate pre-service and in-service training of science teachers.
f. The careful study of science problems by research in existing research organizations, educational institutions, and teacher organizations.
g. A professional clearing house for science teaching problems of local and national significance.
h. Superior materials and effective methods and techniques for science teaching.

WE BELIEVE the American Science Teachers Association a very worthy national organization with which individual science teachers or teacher groups may well ally themselves in an effort to meet present and future needs which cannot be met through local efforts alone.

BOOKS FOR BIOLOGY

(Continued from page 26)

Forbes, Stephen Alfred, and Richardson, Robert Earl. Fishes of Illinois. Urbana, Ill., Natural History Survey, 1920. 2nd ed. $4.00.

c. Habits and activities of animals.

Ditmars, Raymond L. Strange animals I have known. New York, Harcourt, Brace and Company, 1939. (Harbrace ed.) $1.69.

Hegner, Robert William, and Hegner, Mrs. Jane (Zabriskie). Parade of the animal kingdom. New York, Macmillan, 1935. $5.00.

Hornaday, William Temple. American natural history. 16th ed. New York, Scribner, 1935. $5.00.

Curran, Charles Howard, and Kauffeld, Carl. Snakes and their ways. New York, Harper, 1937. $3.50.

Mathews, Ferdinand Schuyler. Book of birds for young people. New York, Putnam, 1921. $3.00.

Hornaday, William Temple. Minds and manners of wild animals. New York, Scribner, 1922. $2.50.

Nelson, Edward William. Wild animals of North America. Washington, D. C., National Geographic Society, 1930. $4.00.

Scoville, Samuel. Wild folks. Boston, Little, 1922. $2.50.

Conservation

Parkins, Almon Ernest, and Whitaker, J. R. Our natural resources and their conservation. New York, John Wiley, 1939. 2nd rev. ed. $5.00. College ed., $4.00.

Van Hise, Charles Richard. Conservation of our natural resources. Edited by Loomis Havemeyer. New York, Macmillan, 1930. $4.00.

Gustafson, Axel Ferdinand, Ries, H., Guise, C. H., and Hamilton, W. J. Conservation in the United States. Ithaca, New York, Comstock Pub. Co., 1939. $3.00.

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SULFUR IN GASOLINE

(Continued from page 21)

tion became acid and turned blue litmus red. Hydrogen peroxide was added to oxidize the sodium sulfite and form sodium sulfate. The HCl was added to facilitate the oxidation of the sodium sulfite. Last, barium chloride was added. If sulfur was present in the gasoline and was in form of sodium sulfate, it would form barium sulfate, a white precipitate.

For this project the students secured samples of most of the different kinds of gasolines sold in Sikeston. In each test, they burned for 25 minutes, samples of the gasoline and added 6 drops of hydrogen peroxide to the solution taken from the U-Tube. They added barium chloride in excess so that all the sulfur would be precipitated. In this manner, results were compared and by indirect means the amount of sulfur in the gasoline was estimated. Of the widely used brands, none of them showed more than traces of sulfur. Two gasolines did contain sulfur. One of these was in the low priced "competition" gasoline of a local firm that is not very widely known. The other was a medium priced "regular gasoline bought on the open market for a local station.

The result of the experiment showed that few gasolines have any sulfur in them and that none of the highly advertised brands contain it.

PRODUCTS FROM MILK

(Continued from page 22)

allowed to stand in drying. The dried product was an inch high and one and three-fourths inches across.

Next, we tried using casein settled directly out of the milk with HCl. It was molded, dyed and hardened without wasting time with drying and treatment with NaOH. This seemed to work fairly well.

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Next, we made glue. Ten grams of casein were filtered out and combined with 25 cc of water. This mixture was allowed to soak for a half hour. Two grams of hydrated lime and ten cc of water were then added. Seven and one half grams of sodium silicate was added to make the glue useful over a long period of time.

The casein paint was made for use on the inside by dissolving the casein in alkali by adding lime, powdered feldspar, powdered asbestos, kaolin, lead chromate, and linseed oil. Lead oxide was added to give the paint a gloss.

For outside paint, casein should be precipitated, filtered from an alkaline solution and ground with linseed oil and lead chromate, or some other pigment, to form a durable paint. The paint made was not very good for covering already painted, dark surfaces.

DUST PRECIPITATION

(Continued from page 23)

Weight of dust collected in twenty-four hours has indicated ninety tons of dust has been prevented from falling on our city.

THE POTENTIAL spark-gap in the table was estimated by the most accurate measurements available.

The electrodes were steel balls one centimeter in diameter and were mounted on an insulator.

Alternating current varying from two to seventeen volts was used in the primary windings of the coil. A Model T Ford spark coil produced the high voltage.

P. volts	Distance cm.	S. volts
2	.0	
4	.25	10,400
6	.29	12,000
8	.34	13,200
9	.37	14,200
10	.39	14,500
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13	.45	16,400
15	.45	16,400
17	.44	16,300

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Chemistry Projects

In this group are found electroplating; hydrogenation of oil; getting sugar from corn; tanning leather and fur; dyeing cloth; examination and purification of water; testing of lubricating oil, paint, baking powder, wool, silk, cotton, rayon, and linen; and making bakelite, cold cream ana vanishing cream, baking powder, mirrors, ink, polish, and plastic wood.

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BOOK SHELF

Magic in a Bottle. Milton Silverman, Ph.D. The Macmillan Co., New York, Y. Y., 1941. 332 pages. $2.50 list.

Silverman gives an exciting account of the stories of real men, with their shortcomings and their attributes, of their discouraging failures and unexpected triumphs, their stubborn devotion and great achievements. This nontechnical account is highly recommended reading for young and old, for layman and teacher. Its style is most graphic and entertaining.

The stories of the discoveries of some of the important drugs, from morphine to sulfapyradine, though imaginary, are based on fact. Magic in a Bottle is a story of the men behind the drugs, their personalities, the impacts of big business, a human interest account.— Joseph Singerman.

The High-School Science Library for 1940-1941. Hanor A. Webb, George Peabody College for Teachers, Nashville, Tennessee. Reprinted from Peabody Journal of Education, Vol. 19, No. 3, November, 1941. 15 pp. Distributed by author.

In this pamphlet the author lists the books he considers most desirable for the library according to groups and also the comparative value to the school when only a limited amount of money is available for purchase. The books are grouped under such headings as "The Spirit of Science," "Science in Industry," "The Health of Man," "Plants of Land and Water," etc. It also indicates the author's opinion of what books should be included in a library if just $10.00 is to be spent, if $25.00 is available, etc. The list price of the books and the publishers are given.

The Foundation of Conservation Education. Pamphlet No. 3, Committee on Conservation Education, Henry B. Ward, Chairman and Editor, Paul B. Sears, and Cyril J. Ballam. Published by The National Wildlife Federation, Washington, D.C., 1941. 242 pp., 14 pictures. 60 cents (paper), $1.00 (buckram).

The Foundations in Conservation Education is the third in a series of pamphlets published by the National Wild Life Association in the field of conservation. The purpose of this edition is to give a clear presentation of the principles of conservation that would be of service in the high school and college field. It is written by several people in widely separated parts of the country, each contributing to the problem as he sees it in his area. Among these are Wesley C. Mitchell of Columbia University; W. C. Loudermilk, U.S. Soil Conservation Service; Paul B. Sears of Oberlin College, and Henry B. Ward of University of Illinois. In spite of the varied contributions the work seems to be well coordinated and leads to a practical understanding of our present and future conservation problem. It attempts to expose "fools conservation projects" and to indicate a sane basis for consideration of the matter.

ILLINOIS ASSOCIATION

(Continued from page 7)

A field trip in the morning has been arranged to the Mueller Company of Decatur, where the operation of a brass foundry and the making of plumbing fixtures may be observed.

Registration is at 9:00 a.m. at the senior high school. There will be a luncheon at noon. Reservations should be made with C. W. Dewalt of the senior high school of Decatur. Every chemistry teacher in the state is urged to attend the meeting.

PROJECTS FOR PHYSICS

(Continued from page 35)

SOMETIMES a project has been useful enough to warrant its purchase by someone. For instance, one boy was able to sell his model of a farm electrically lighted to a farm adviser, who used it to illustrate to farmers how their farms might be wired. Another boy made considerable money with his P.A. system which he rented and operated for small dances.

The project may be one of the most important teaching devices, not only because it tends to link physics with daily life, but also because it is one thing that the student will not soon forget since he has labored long and diligently on it.

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This book introduces the reader to the technique of observation and then proceeds to analyse the present state of our knowledge of variable stars. The Cepheid variables provide not only information about the deep interiors of stars, but they also prove to be a useful yardstick for sounding the universe. Among the types of variable stars discussed are the Explosive star or Nova, the giant red variables, erratic stars and eclipsing stars. The principles of spectroscopy and technical aspects are explained in the appendix. A list of brighter variables, a Julian calendar and other tables are included.

82 Illus; 226 Pages; $2.50 (1941)

Earth, Moon and Planets

By Fred L. Whipple

This book presents in nontechnical language a concise, well-illustrated account of the planets, their atmospheres and the possibilities of life outside the earth. Special attention is given to the problems of origin and evolution, particularly the origin of lunar craters and the evolution of the planets. Planetary motions and the workings of Newton's Law of Gravitation are explained. The Charts of the Moon and Mars enable the reader to identify the more conspicuous markings seen in the photographs or through the telescope. A feature of special value is the Planet Finder and Star Chart which enables the reader to locate directly the planets at any time from the present through 1970.

140 Illus; 293 Pages; $2.50 (1941)

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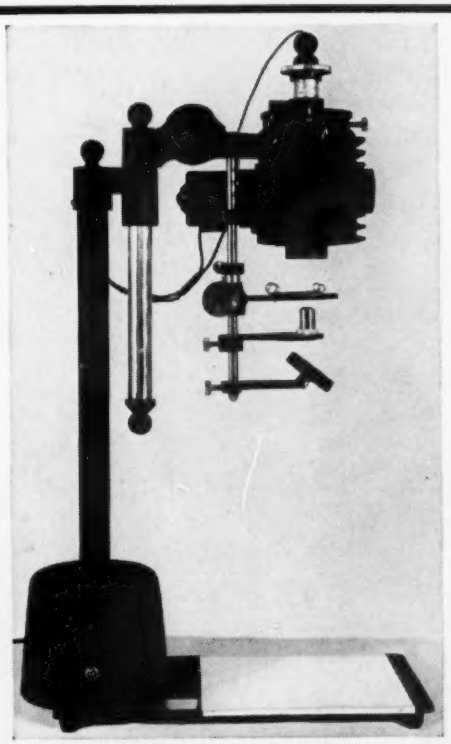

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